

What is Claimed is:

1. A knife-edge conditioning apparatus for modifying the physical structure along an elongated edge of a metal knife blade, the blade having two faces that at their terminus have been sharpened forming two facets that intersect to create the elongated edge at the junction of the two edge facets, said apparatus comprising at least one precision angle knife guide with which one face of the blade maintains sustained sliding or rolling contact in order to guide the elongated edge of the blade into sustained contact with the hardened surface of an object and positions the plane of one edge facet at a precise predetermined angle B relative to the plane of contact with said hardened surface made of material at least as hard as the metal of the knife blade without tendency to abrade as the blade face is moved along said guide with its elongated edge in sustained contact with said hardened surface.
2. A knife-edge conditioning apparatus according to Claim 1 for modifying the physical structure along the elongated blade edge where said precision knife guide has an elongated surface against which the face of the blade maintains sustained contact.
3. A knife-edge conditioning apparatus according to Claim 1 for modifying the physical structure along the elongated blade edge where the effective length of the elongated precision knife guide is not less than about one inch in length.

4. A knife-edge conditioning apparatus according to Claim 1 for modifying the physical structure along the elongated blade edge comprising at least one said hardened surface and at least one of said knife guides adjacent said surfaces including a physical member that contacts the knife blade and applies a force to press the blade against said knife guide as the blade is moved along said knife guide with the knife edge in sustained contact with said hardened surface.
5. A knife-edge conditioning apparatus according to Claim 1 for modifying the physical structure along the elongated blade edge comprising a set of said hardened surfaces and one of said knife guides adjacent said surfaces including an inverted U shaped spring member having cantilevered resilient arms and an intermediate connection portion, said connecting portion being between said set of hardened surfaces and each of said arms of said spring member extending downwardly generally along a portion of a respective one of said precision knife guides
6. A knife-edge conditioning apparatus according to Claim 1 for modifying the physical structure along the elongated blade edge where the predetermined angle B of the adjacent facet relative to said contacted plane of said hardened surface is less than 10 degrees.
7. A knife-edge conditioning apparatus according to Claim 1 for modifying the physical structure along the elongated blade edge where said hardened surface is the surface of a stationary cylindrical object with its axis mounted

nominally perpendicular to the elongated edge of said blade.

8. A knife-edge conditioning apparatus according to Claim 1 for modifying the physical structure along the elongated blade edge where said hardened surface is the surface of a rotateable cylindrical object with its axis mounted nominally perpendicular to the elongated edge of the blade.
9. A knife-edge conditioning apparatus according to Claim 8 for modifying the physical structure along the elongated blade edge where a braking mechanism prevents rotation of said rotateable cylindrical object unless a torque is applied to said cylinder in excess of that applied by such braking mechanism.
10. A knife-edge conditioning apparatus according to Claim 1 for modifying the physical structure along the elongated blade edge where said hardened surface of said object is restrained in a predetermined rest position relative to adjacent said precision knife guide by a restraining mechanism that applies a restraining force to position said object in said position said object being displaceable against said force of said mechanism by the force applied by the blade facet contacting said hardened surface of said object.
11. A knife-edge conditioning apparatus according to Claim 7 for modifying the physical structure along the elongated blade edge where the said cylindrical object is adjustable in order that different areas of the hardened

surface of said cylindrical object can be selected as the contact point with the adjacent edge facet.

12. A knife-edge conditioning apparatus according to Claim 1 for modifying the physical structure along the elongated blade edge where said hardened surface of said object is serially grooved at the point of contact of said hardened surface with the elongated edge, and said grooves being oriented angularly to cross the elongated edge as the edge is moved across said grooved hardened surface.

13. A manual knife-edge conditioning apparatus for modifying the physical structure along an elongated edge of a metal knife blade, the blade having two faces that at their terminus have been sharpened forming two facets that interact to create the elongated edge at the junction of the two edge facets, said apparatus comprising at least one precision angle knife guide with which one face of the blade maintains sustained sliding or rolling contact in order to guide the elongated edge of the blade into sustained contact with the hardened surface of an object and positions the plane of one adjacent edge facet at a precise predetermined angle B relative to the plane of contact with said hardened surface made of material at least as hard as the metal of the knife blade as the blade is moved along said guide with its elongated edge in sustained contact with said hardened surface.

14. An apparatus according to Claim 13 where said blade guides are elongated including an inverted U shaped

spring member having cantilevered resilient arms and an intermediate connecting portion over said edge sharpening, edge conditioning, and finishing stages with at least one of said resilient arms extending downwardly generally along a portion of said blade guides.

15. A knife-edge conditioning apparatus for modifying the physical structure along an elongated edge of a metal knife blade, the blade having two faces that at their terminus have been sharpened forming two facets that intersect at their terminus to create the elongated edge, said apparatus consisting of at least one angle knife guide designed to insure reproducibly and precisely guiding the blade edge into contact with at least one hardened surface and aligning at angle B the plane of contact with at least one blade facet relative to the plane of said hardened surface at the point of the edge contact with said hardened surface with an angular precision of better than 3 degrees.

16. An apparatus for sharpening and conditioning the edge of a blade with two faces, an elongated cutting edge and with a facet adjacent to each face intersecting to form the cutting edge, comprising at least one sharpening stage and at least one edge conditioning stage, said sharpening stage comprising at least one disk having an exposed abrasive surface, said disk being mounted on a shaft for rotation, a blade guide surface juxtaposed said disk to guide one side face of blade to bring the blade edge into contact with a surface of said rotating disk, said blade guide surface being at a predetermined vertical angle A relative to the plane of surface of said

disk at point of contact with the blade facet, said blade guide surface being in a plane that intersects said abrasive surface, said edge conditioning stage comprising at least one associated precision angle blade guide with which said face of said blade maintains sustained contact and which guides said elongated blade cutting edge into contact with the hardened surface of at least one object, said plane of associated blade guide being at a predetermined angle C relative to plane of said hardened surface at point of contact of the blade edge with said hardened surface having a hardness at least as hard as the blade edge.

17. An apparatus according to Claim 16 where said object in a rest position can be displaced by the force exerted by the blade edge against said hardened surface of said object against the predetermined restraining force of a resilient means that upon release of said force repositions said hardened surface to said rest position.
18. An apparatus according to Claim 16 where the angular difference between angle A and angle C is less than 10 degrees.
19. An apparatus according to Claim 16 where said blade guide of said edge conditioning stage is elongated including an inverted U shaped spring member having cantilevered resilient arms and an intermediate connecting portion being over said hardened surface with at least one of said resilient arms extending downwardly generally along a portion of said blade guide.

20. An apparatus according to Claim 16 where said hardened surface is the surface of a cylindrical object with its axis nominally perpendicular to the elongated edge of said blade.
21. An apparatus according to Claim 20 where a braking mechanism prevents rotation of said cylindrical object unless a torque is applied to said hardened surface of said cylinder by the blade edge in excess of that applied by said braking mechanism.
22. An apparatus according to Claim 19 where structure is included to adjust the position of said object in order that different areas of the hardened surface of said cylindrical object can be selected as the contact point with the elongated blade edge.
23. An apparatus according to claim 16 where said hardened surface is serially grooved at the point of contact of said hardened surface with the elongated edge, said grooves being angularly oriented to cross the elongated edge as the edge is moved across said grooved hardened surface.
24. An apparatus for sharpening and conditioning the edge of a blade with two faces, an elongated cutting edge and a facet adjacent to each face intersecting to form the cutting edge, comprising a sharpening stage, an edge conditioning stage and an edge finishing stage, said sharpening stage comprising at least one disk having an exposed abrasive surface, said disk being mounted on a shaft for rotation, a blade guide surface juxtaposed said disk to guide one face of the blade to bring the blade

edge into contact with surface of said rotating disk, said blade guide surface being at a predetermined vertical angle A relative to the plane of abrasive surface of said disk at point of contact with the blade edge, said blade guide surface being in a plane that intersects said abrasive surface, said edge finishing stage comprising at least one associated precision angle blade guide with which the face of the blade maintains sustained contact and which guides the elongated blade cutting edge into contact with the hardened surface of at least one object, said plane of said associated blade guide being at a predetermined angle C relative to plane of said hardened surface at point of contact of the blade edge with said hardened surface having a hardness at least as great as the blade edge, said finishing stage comprising at least one finishing disk having an exposed abrasive surface, said finishing disk being mounted on a shaft for rotation, one finishing blade guide surface juxtaposed said disk to guide one face of the blade to bring the blade edge into contact with the surface of said rotating disk, said finishing blade guide surface being in a plane that intersects said abrasive surface, set at predetermined angle D relative to the plane of the abrasive surface of said disk at point of contact with the blade edge.

25. An apparatus according to Claim 24 where the angular difference between angle A and angle C is less than 10 degrees and the angular difference between angle A and D is less than 3 degrees.



26. An apparatus according to Claim 24 where said object in a rest position can be displaced by the force exerted by the blade edge against said hardened surface of said object against the predetermined restraining force of a resilient structure that upon release of said force repositions said hardened surface to said rest position.
27. An apparatus according to Claim 25 where said blade guides are elongated including an inverted U shaped spring member having cantilevered resilient arms and an intermediate connecting portion over said edge sharpening, edge conditioning, and finishing stages with at least one of said resilient arms extending downwardly generally along a portion of said blade guides.
28. An apparatus according to Claim 24 where said hardened surface of said object is the surface of a cylindrical object with its axis nominally perpendicular to the elongated edge of said blade.
29. An apparatus according to Claim 28 where a braking mechanism prevents rotation of said cylindrical object unless a torque is applied to said hardened surfaces of said cylinder by the blade edge in excess of that applied by said braking mechanism.
30. An apparatus for sharpening and conditioning the edge of a blade with two faces, an elongated cutting edge and with a facet adjacent to each face intersecting to form the cutting edge, comprising at least one sharpening stage and at least one edge conditioning stage, said sharpening stage comprising at least one abrasive surface and at least one blade guide juxtaposed said abrasive

surface to guide one side face of blade to bring the blade edge into contact with said abrasive surface, said blade guide surface being at a predetermined angle A relative to the plane of said abrasive surface at point of contact with the blade facet, said edge conditioning stage comprising at least one associated precision angle blade guide with which the face of the blade maintains sustained contact in order to guide the elongated blade cutting edge into sustained contact with the hardened surface of at least one object, said plane of associated blade guide being at predetermined angle C relative to plane of said hardened surface at point of contact of the blade edge with said hardened surface having a hardness equal to or greater than the blade edge.

31. An apparatus according to Claim 30 where said object in a rest position can be displaced by the force exerted by said blade edge against said hardened surface of said object against the predetermined restraining force of a resilient structure that upon release of said force of the blade edge repositions said hardened surface to said rest position.
32. An apparatus according to Claim 30 where the angular difference between angle A and angle C is less than 10 degrees.
33. An apparatus according to Claim 30 where at least one of said blade guides includes a spring type member that contacts the blade providing a restraining force that presses the side face of the blade into contact with said blade guide surface.

34. An apparatus according to Claim 30 where said blade guide of said edge conditioning stage is elongated including an inverted U shaped spring member having cantilevered resilient arms and an intermediate connecting portion being over said hardened surface with at least one of said resilient arms extending downwardly generally along a portion of said blade guide.
35. An apparatus according to Claim 31 where said hardened surface is the surface of a cylindrical object with its axis nominally perpendicular to the elongated edge of the blade.
36. An apparatus according to Claim 34 where a braking mechanism prevents rotation of said cylindrical object unless a torque is applied to said hardened surface of said cylinder in excess of that applied by said braking mechanism.
37. An apparatus according to Claim 35 where structure is included to adjust the position of said object in order that different areas of the hardened surface of said cylindrical object can be selected as the contact point with the elongated blade edge.
38. An apparatus according to Claim 30 where said hardened surface is serially grooved at the point of contact of said hardened surface with the elongated edge, and said grooves being angularly oriented to cross the elongated edge as the edge is moved across said grooved hardened surface.
39. A manual knife-edge conditioning apparatus for modifying the physical structure along an elongated edge

of a knife blade, the blade having two faces that at their extremity each have a facet that intersects to form the elongated edge, said apparatus comprising an angle guide for sliding contact with one face of the blade to direct the edge into sliding physical contact with two or more hardened surfaces without tendency to abrade located at least one on each side of the edge where the plane of said surfaces at the point of contact with the edge on a given side of the edge are aligned at the same predetermined angle relative to the plane of the facet adjacent to that side of the edge.

40. A combined apparatus with a knife sharpener and an edge conditioning assembly for modifying the physical structure of the elongated edge of a knife blade, the blade having two faces that at their extremity each have a facet that intersects to form the elongated edge, said knife sharpener comprising at least one abrasive surface for abrading the facet, and the edge conditioning assembly comprising an angle guide for physical contact with the blade to direct the edge into sliding physical contact with the hardened surface of an object made of a material without tendency to abrade, said material being at least as hard as the blade when the blade is moved along said guide with its elongated edge in contact with said hardened surface.

41. A combined apparatus with a knife sharpener and an edge conditioning assembly for modifying the physical structure of the elongated edge of a knife blade, the blade having two faces that at their extremity each have a facet that intersects to form the elongated edge, said

knife sharpener comprising at least one skiving surface for skiving said facet, and said edge conditioning assembly comprising an angle guide for physical contact with the blade to direct the edge into sliding physical contact with at least one hardened surface of an object made of a material without tendency to abrade, said material being at least as hard as the blade when the blade is moved along said guide with its elongated edge in contact with said hardened surface.

42. An apparatus comprising a facet sharpening stage and an edge conditioning stage for a knife blade having two faces that at their extremities have facets that intersect to create an elongated edge at the terminus of the two edge facets, said facet sharpening stage comprising at least one hardened or abrasive member that removes metal from the entire facet surfaces to create a new facet along the blade edge, said edge conditioning stage comprising at least one hardened surface and at least one precision angle knife guide with which the blade maintains sustained contact in order to guide the lower portion of one or more of the facets adjacent the edge into contact with said hardened surface, the angular plane of said hardened surface at the area of contact positioned sufficiently different from the angular plane of the surface of the contacting facet to insure that said contact is made only at the terminus or lower portion of the facets adjacent to the terminus.

43. An apparatus according to Claim 42 where the said angular difference B between said angular plane of said

hardened surface and the plane of the facet is finite and less than  $10^\circ$ .

44. A knife-edge conditioning apparatus for modifying the physical structure along an elongated edge of a metal knife blade, the blade having two faces that at their terminus have been sharpened forming two facets that intersect to create the elongated edge at the junction of the two edge facets, said apparatus comprising at least one hardened surface and at least one precision angle knife guide with which the blade maintains sustained contact in order to guide the lower portion of one or more of the facets adjacent the edge into contact with said hardened surface, the angular plane of said hardened surface at the area of contact positioned sufficiently different from the angular plane of the surface of the contacting facet to insure that said contact is made only at the elongated edge or the lower portion of the facets adjacent the edge.

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